N° 11,293 A.D. 1915

Date of Application, 4th Aug., 1915

Complete Specification Left, 4th Feb., 1916—Accepted, 22nd June, 1916

PROVISIONAL SPECIFICATION.

Improvements in or relating to Internal-combustion Engines.

I, FREDERICK LAMPLOUGH, Consulting Engineer, of Trafalgar House, Waterloo Place, London, S.W., do hereby declare the nature of this invention to be as follows:—

This invention is for improvements in or relating to internal-combustion engines, particularly to engines of the type comprising two pistons arranged end-on in a single cylinder or its equivalent common to both of them. In such an engine the combustible charge is led into a space between the adjacent or inner ends of the two pistons by which charge, when it is fired, they are forced apart in opposite directions. The cylinder has inlet and outlet ports for the admission of combustible gases to and the exhaust of the spent gases from the cylinder respectively, which ports are connected with the space that is between the adjacent piston-ends at the times when the functions of the ports are required.

The invention is chiefly applied to engines working on the two-stroke cycle and one of the objects of the invention is to provide a better balanced engine than heretofore.

According to a feature of the present invention such an engine of the type above described is characterised by the outer ends of both pistons working in closed cylinders (preferably of larger diameters than that of the working cylinder) the said piston-ends constituting pumps or compressors, one for scavenging air and the other for combustible gas or mixture.

Preferably, if the engine is a two-stroke engine, one of the pistons is hollow and is open at its outer end and is furnished with a non-return valve in its inner end, the said piston controlling the inlet port while the other piston controls the exhaust port. The purpose of the said hollow piston is to compress within it, and between it and the outer end of its cylinder, air drawn into the latter during a previous stroke in the reverse direction. The compressed air is forced through the non-return valve, when it has been compressed to a degree greater than the pressure exerted on the other face of the valve, the air thus supplied to the cylinder being used for scavenging the cylinder of spent gases. The inlet and exhaust ports are controlled by the two pistons in the sense that they are covered and uncovered by the pistons which obviate the necessity of any other valves controlling the inlet and exhaust of the gases to and from the cylinder.

A further feature of the invention consists in the inlet and exhaust ports being so positioned in the wall of the working cylinder that the exhaust port is uncovered by its piston prior to the uncovering of the inlet port by the other piston controlling it.

A further feature of the invention consists in connecting the piston with its rocking lever at a point intermediate between its two ends.

The invention also includes a hollow piston having cylindrical end-portions and a flattened middle-portion for engagement with the rocking lever hereinbefore referred to.

[*Price 6d.*]

Another feature of the invention comprises the combination with the working cylinder of a surrounding jacket providing a space between it and the working cylinder, through which space the combustible gases are fed to a port communicating with the interior of the working cylinder.

Other features of the invention will be more clearly understood from the following description which is that of a preferred embodiment of the invention constituted by an engine working on the two-stroke cycle and embodying *inter alia* all the features hereinbefore set forth.

A single cylinder is adapted to receive the inner ends of two pistons each of which has cylindrical end-portions with a flattened middle-portion between the two ends. The inner cylindrical ends of the pistons (that is the adjacent ends) are of smaller diameter than their outer ends. Connected with each end of the aforesaid cylinder, conveniently by means of a screw-connection, is a casting which includes an enlarged hollow chamber which is adjacent to the working piston aforesaid, the outer end of the casting constituting a cylinder for the enlarged outer end of the piston.

Mounted in the lower portion of each of the enlarged chambers is a rock shaft having rigidly secured to it two rocking levers side by side and extending at their upper ends on either side of the flattened portion of the piston. At their upper ends they are pivotally connected to intermediate levers which are in their turn pivotally connected with the piston conveniently by a screw-and-bolt connection or the like with that portion of the circular face of the enlarged end which is on either side of the flattened or restricted middle-portion. At their lower ends the rocking levers are pivotally connected to a connecting rod which in its turn is connected with a crank on the crank-shaft. Thus the crank-shaft has two cranks set at 180° apart so that the pistons are so connected with it that they are opposed to one another, that is to say, the pistons move simultaneously either away from one another or towards one another.

The enlarged chambers are provided with inspection holes and covers therefor screw-connected or otherwise secured in place.

One of the pistons is hollow and is open at its outer end. In its inner circular end face is a spring-controlled non-return valve set in any convenient valve-seating and opening in a direction to admit air from the hollow piston into the working cylinder. The cylinder or part in which the outer end of the piston works is provided with an air-inlet port controlled by a non-return valve conveniently of the flexoid type so that as the piston moves inwardly air is drawn into the outer cylinder and into the hollow piston. As the latter moves outwardly under the influence of the fired charge, the air is compressed by the piston in the outer cylinder until such time as the degree of compression exceeds the pressure of the explosive charge in the working cylinder.

Near the extremity of that end of the working cylinder which is appropriated to the piston just described, is an inlet port, or conveniently a series of inlet ports peripherally disposed, which are adapted to be uncovered by the inner end of the piston just before it reaches the limit of its outward stroke.

The other piston is also hollow and its inner end is closed by a weighted central portion constituting a balancing or equalising weight for the non-return valve in the inner end of the first described piston. The inner end of this second piston operates to control an exhaust port or a series of peripherally-disposed exhaust ports near the outer end of the working cylinder appropriated to the second piston. The exhaust ports are preferably longer in the direction of the length of the cylinder than are the inlet ports, (or the exhaust ports are so disposed in the cylinder-wall) so that they are uncovered by the second piston before the inlet ports are uncovered by their piston.

The cylinder surrounding the outer end of the second piston is in connection with a carburettor of any convenient type through the medium of a non-return valve, preferably of the flexoid type, so that during the inner stroke of the piston a combustible gas-mixture is drawn into the cylinder and into the interior of the piston whose outer end is open. On the outer stroke of the piston the gas-mixture thus drawn into the cylinder is forced out through another passage controlled by a non-return valve, also preferably of the flexoid type, into a reservoir. The reservoir is connected, through the medium of a throttle-valve, with a chamber formed between the outer wall of the working cylinder and a jacket surrounding the latter and spaced from it. It is with this space that the inlet ports, cut through the wall of the working cylinder, communicate.

The ignition may be of any preferred type and is connected with a sparking plug arranged substantially centrally between the inner ends of the two pistons which, at the limit of their inward strokes, remain separated by a predetermined compression space.

It will be understood that in operation, assuming that the two pistons are both at the limit of their inward strokes and have received a combustible charge in the space between them, after the charge has been fired the two pistons are forced apart in opposite directions. One piston which has drawn air into its outer cylinder compresses the air as above described while the other piston, which has previously drawn a gas-mixture from the carburettor into its outer cylinders, compresses the mixture and forces it into the reservoir. The engine is preferably so designed that on the explosion stroke or outward stroke the pressure of the fired gases falls at such a rate and the compression of the air by the piston aforedescribed increases at such a rate that before the inlet ports are uncovered a large proportion of the air has passed through the valve in the piston into the working cylinder. The other piston then uncovers the exhaust ports and the spent gases exhaust therethrough while the scavenging air follows them up and aids in clearing the cylinder of the spent gases. This scavenging air also helps to cool the cylinder. Shortly after the above described operations, the inlet ports are uncovered and the combustible mixture passes into the working cylinder from the reservoir and follows up the air-charge, forcing a portion or the whole of it out through the exhaust ports according to the amount of the charge admitted. It should be here remarked that the aforedescribed gas-reservoir is connected with the space provided between the cylinder and the surrounding sleeve at that end remote from the inlet ports so that the incoming charge passes in contact over substantially the whole or at least the major portion of the length of the cylinder and aids in cooling the latter.

When the pressure in the reservoir has attained a certain value, it will become equal in degree and opposed to the pressure of the piston pumping the gas-mixture into the reservoir. Thus the delivery from the piston or pump is automatically controlled by the rise and fall of pressure in the reservoir, only the proportion used through the throttle being accounted for on each stroke by the piston until the maximum speed is reached when the whole of the charge will be utilised.

By the arrangement above described a substantially constant compression is maintained and the firing cylinder is kept internally and externally cooled obviating the necessity for using any other cooling medium in the form of water, gills or fans.

It is obvious that any number of units can be coupled together for the purpose of increasing the power and regularity or turning movement but in each case a similarity of construction may be observed, it being only necessary to enlarge the crank-chambers accordingly.

Although the invention has been described in detail, it is obvious that many details may be modified; for example, in the connections between the pistons

and the crank-shaft, in the types of valves employed and the like, provided always that the spirit of the invention is not departed from.

Dated this 4th day of August, 1915.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, London, E.C.,
Chartered Patent Agents.

COMPLETE SPECIFICATION.

Improvements in or relating to Internal-combustion Engines.

I, FREDERICK LAMPLOUGH, Consulting Engineer, of Trafalgar House, Waterloo Place, London, S.W., do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to internal combustion engines, particularly to engines of the type comprising two pistons arranged end-on in a single cylinder. In such an engine the combustible charge is led into the space between the adjacent or inner ends of the two pistons, and the charge, when it is fired forces the pistons apart in opposite directions. The cylinder has inlet and outlet ports for the admission of combustible gases to and the exhaust of the spent gases from the cylinder respectively, which ports are connected with the space that is between the adjacent piston ends at the times when the functions of the ports are required.

The invention is chiefly applicable to engines working on the two-stroke cycle.

If the engine is a two-stroke engine, one of the pistons is hollow and is open at its outer end and is furnished with a non-return valve in its inner end, the said piston controlling an inlet port distinct from the passages which deliver (as hereinafter explained) into the hollow piston while the other piston controls the exhaust port. The purpose of said hollow piston is to compress within it and between it and the outer end of its cylinder, air drawn into the latter during a previous stroke in the opposite direction. The compressed air is forced through the non-return valve when it has been compressed to a degree greater than the pressure exerted on the other face of the valve, the air thus supplied to the cylinder being used for scavenging the cylinder of spent gases. The inlet and exhaust ports are controlled by two pistons in the sense that they are covered and uncovered by the pistons which obviate the necessity for any other valves controlling the inlet and exhaust of the gases to and from the cylinder.

The piston is connected on its exterior with a rocking lever, at a point intermediate between the ends of the piston.

One of the pistons is a hollow piston having cylindrical end-portions and a flattened middle portion for engagement with the rocking lever hereinbefore referred to.

Other features of the invention will be more clearly understood from the following description which is that of a preferred embodiment of the invention constituted by an engine working on the two-stroke cycle and embodying *inter alia* all the features hereinbefore set forth.

In the accompanying drawings—

Figure 1 is a central sectional elevation of the engine.

Figure 2 is a section on the line 2—2 of Figure 1, and

Figure 3 is a section on the line 3—3 of Figure 1.

Like letters indicate like parts throughout the drawings.

A single cylinder A is adapted to receive the inner ends of two pistons B, C, each of which pistons has cylindrical end-portions with flattened middle portions B^1 and C^1 respectively between the two ends. The inner or adjacent cylindrical ends of the pistons are of smaller diameter than their outer ends B^2 C^2 respectively. Connected with each end of the aforesaid cylinder A are castings of which one includes an enlarged hollow chamber D, adjacent to the working cylinder B, and a cylinder D^1 at the outer end of the casting to receive the enlarged end B^2 of the piston B. The casting may be connected with the cylinder A by screw or other connection, for example a brazed connection, as may be found desirable. At the other end of the cylinder A is another casting comprising an enlarged chamber E and a cylinder E^1 for the enlarged end C^2 of the other piston.

Mounted in the lower portion of each of the enlarged chambers D, E, is a fixed shaft F having on it two rocking levers F^1 side by side as shown in Figure 3. These rocking levers extend at their upper ends on either side of the flattened middle portion B^1 or C^1 of the piston to which they are secured and they are connected pivotally at F^2 with intermediate links F^3 which latter are in their turn pivotally connected at F^4 with the piston. The pivot of this latter connection is conveniently secured by means of screw bolts F^5 engaged with that portion of the circular face of the enlarged end of the piston which is on either side of the flattened or restricted middle portion shown in Figure 3 at B^3.

At their lower ends the rocking levers are pivotally connected at F^6 to connecting rods G whose big ends are received on cranks G^1 on the crank-shaft G^2. Thus the latter has two cranks set at, or approximately at, 180° apart and the pistons are so connected with it that they are opposed to one another in their movements that is to say, they move simultaneously either away from or towards one another during the running of the engine.

The enlarged chambers D and E are provided with inspection holes with covers D^2 and E^2 respectively.

The piston B B^1 B^2 is hollow and is open at the end B^2. At its other end is a non-return valve H controlled by a spring H^1 to admit air from the hollow piston to the working cylinder through orifices H^2 formed in the valve seating. A protective perforated cover H^3 is provided for the valve.

The other piston is also hollow and has its inner end closed by means of a central portion J of a weight equal to that of the non-return valve H and its seating in the inner end of the piston B, so that both pistons shall possess equal mass.

The cylinder D^1 is provided with an air inlet port controlled by means of a non-return valve D^3 conveniently of the spring-plate or flexoid type so that as the piston B moves inwardly in the cylinder A air is drawn into the cylinder D^1 and into the hollow piston. As the piston B however moves outwardly under the influence of the fired charge, the air is compressed within the piston until the degree of compression exceeds the pressure in the working cylinder.

The piston B controls peripherally disposed inlet ports A^1 when it approaches the limit of its outward stroke.

The inner end of the piston C controls, in a similar manner, peripherally disposed exhaust ports A^2 which communicate with a common exhaust pipe A^3. The ports A^2 are preferably longer in the direction of the length of the cylinder than are the ports A^1 and are so disposed in the cylinder-wall that they are uncovered by the piston C before the ports A^1 are uncovered by the piston B.

The piston in the cylinder E^1 draws from a carburettor K of any convenient type through the medium of a pipe K^1 and a non-return valve E^3 preferably of the spring-plate or flexoid type as shown, so that during the inward stroke of the piston C gas mixture is drawn from the carburettor into the cylinder E^1 and into the interior of the piston C.

On the outward stroke of the piston C the gas mixture thus drawn into the cylinder is forced out through another port controlled by a non-return valve E^4, similar in type to the valve E^3, into a reservoir L.

The ports controlled by the flexible valve D^3 E^3 E^4 are out of the plane of section, so that they do not appear in the drawing.

It will be seen that the cylinder E^1 forms part of a casting which includes a surrounding casing containing the valves E^3 and E^4 and the ports which they control and containing also a chamber L^1 in communication with the reservoir L. The valve E^4 is conveniently held down on to its seating at its central point by means of a set screw E^5 passing through a cover plate E^6 closing an inspection opening in the casting.

The reservoir L is connected, through the medium of a throttle valve L^2 with a chamber L^3 formed also in the casting containing the chambers E, E^1; and the chamber L^3 is itself in communication with a jacket A^4 surrounding the cylinder A. This jacket is connected at its two ends in an airtight manner with the chamber L^3 and the casting containing the chamber D respectively. It is with the space between the cylinder A and the jacket A^4 that the inlet ports A^1 will be seen to communicate. The sparking plug socket A^5 is provided as shown and any convenient form of crank-chamber and other accessories as may be necessary are provided.

In Figure 2 a magneto M is shown conveniently supported upon a portion of the casing and driven from the crank-shaft by gears M^1 and M^2.

It will be understood that in operation, assuming the parts are in the position shown and a combustible charge is in the compression space formed between the adjacent ends of the pistons B and C, after the charge has been fired the pistons B and C are forced apart in opposite directions rotating the crank-shaft G^2. The piston B which in a previous inward stroke had drawn air into the cylinder D^1 now compresses the air as previously described while the other piston C compresses in the cylinder E^1 a charge of explosive mixture which it had, in a previous inward stroke, drawn into the cylinder E^1 and the space surrounding the latter. The piston C forces, then, on its outward stroke a charge of combustible mixture through the valve E^4 into the reservoir L.

The engine is preferably so designed that on the explosion or outward stroke the pressure of the fired gases falls at such a rate, and the compression of the air in the cylinder D^1 increases at such a rate that before the inlet ports A^1 are uncovered a large proportion of the compressed air has passed through the valve H into the working cylinder A. The other piston then uncovers the exhaust ports A^2, before the ports A^1 are opened, and the spent gases are exhausted through the ports A^2 and pipe A^3 and the scavenging air follows them up and aids in clearing the cylinder of spent gases. This scavenging air also helps to cool the cylinder. Following on the above described operation the ports A^1 are uncovered and combustible mixture from the reservoir L passes into the working cylinder and follows up the scavenging air forcing a portion or the whole of it out through the exhaust ports A^2 according to the amount of the charge admitted. It should be here remarked that the reservoir L is so connected with the jacket surrounding the cylinder A that, as will be seen from the drawings, the incoming charge of combustible gases passes in contact with the outer surface of the cylinder over substantially its entire length and aids in cooling the cylinder.

By the arrangement above described a substantially constant compression is maintained and the firing or working cylinder A is kept internally and externally cooled thereby obviating the necessity of using any other cooling medium in the form of water, gills on the cylinder or fans.

It is obvious that any number of units can be coupled together for the purpose of increasing the power and regularity of the turning moment of the shaft but in each case a similarity of construction may be observed, it being only necessary to enlarge the crank-chambers.

Improvements in or relating to Internal-combustion Engines.

Although the invention has been described in detail it is obvious that many details may be modified; for example in the connections between the pistons B and C and the crank-shaft G^2, and in the types of valves employed provided always that the spirit of the invention is not departed from.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a balanced engine having a working-cylinder alongside the crank-case, the provision at each end of that cylinder of a casing which contains a chamber such as D or E that is situated between the working-cylinder and the pump-cylinder (D^1 or E^1) for the purpose of containing exterior to the piston the upper ends of rocking levers such as F^1 as well as the connections extending from those levers to the piston.

2. A balanced engine having pistons in line moving in opposite directions and characterised by one piston being hollow, and, for the purpose described, open at its outer end, with a non-return valve in its inner end, the said piston controlling an inlet port (A^1) distinct from the passages which deliver fluid to the inside of the hollow piston and the other piston controlling the exhaust port.

3. The internal-combustion balanced engine shown in the drawings.

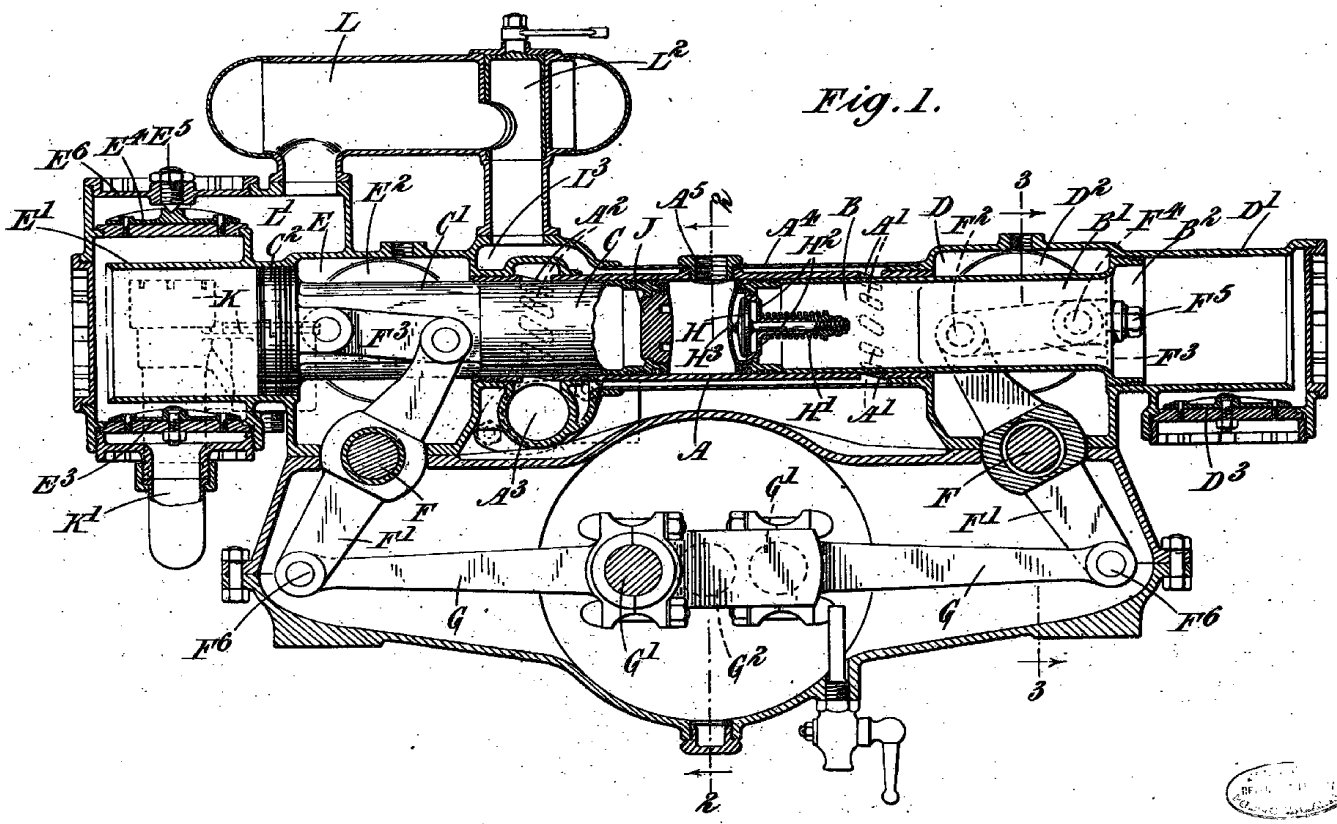
Dated this 4th day of February, 1916.

BOULT, WADE & TENNANT,
111/112, Hatton Garden, London, E.C.,
Chartered Patent Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1916.

[This Drawing is a full-size reproduction of the Original.]

Fig. 1.



Malby & Sons, Photo-Litho

[This Drawing is a full-size reproduction of the Original.]

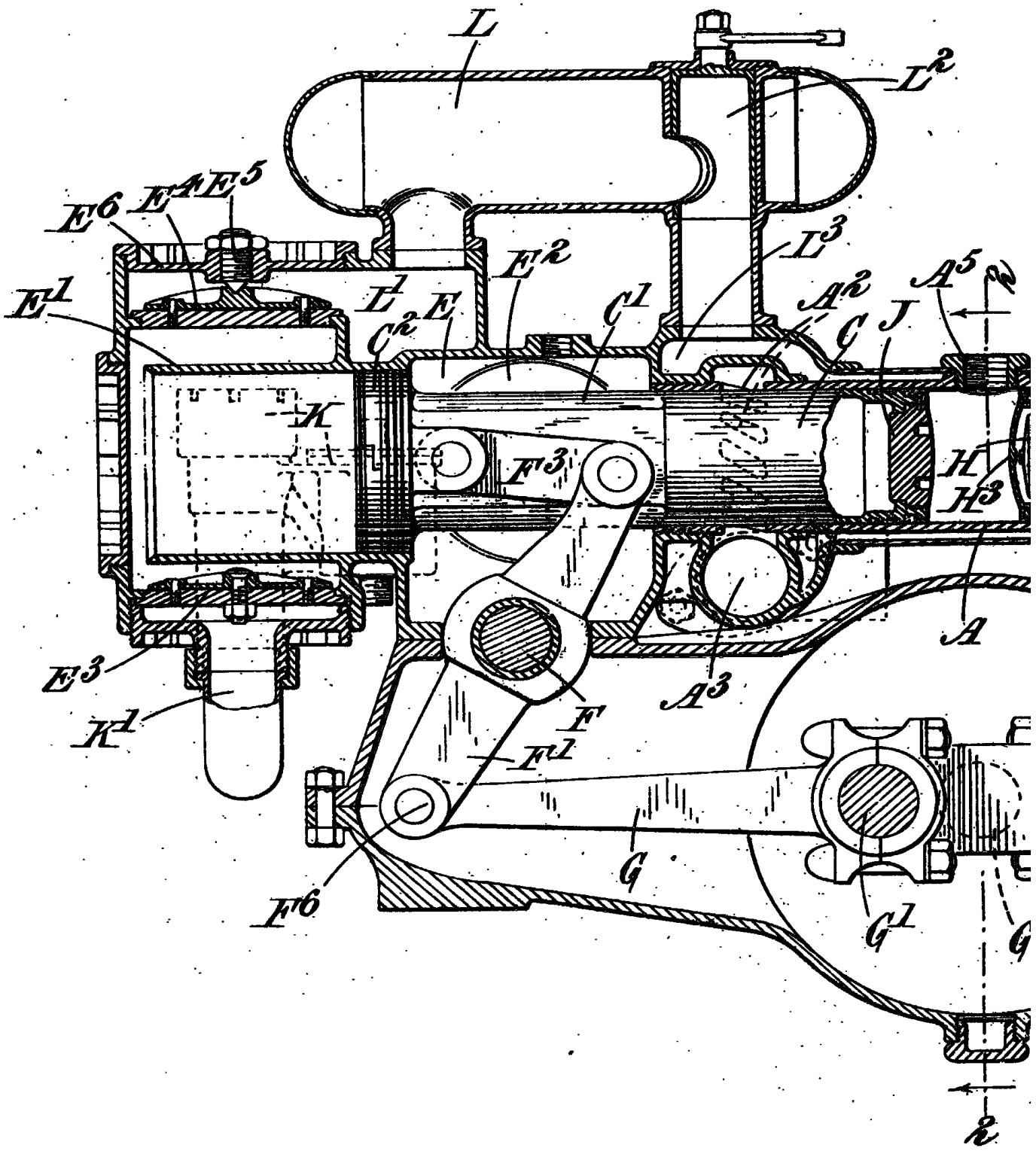
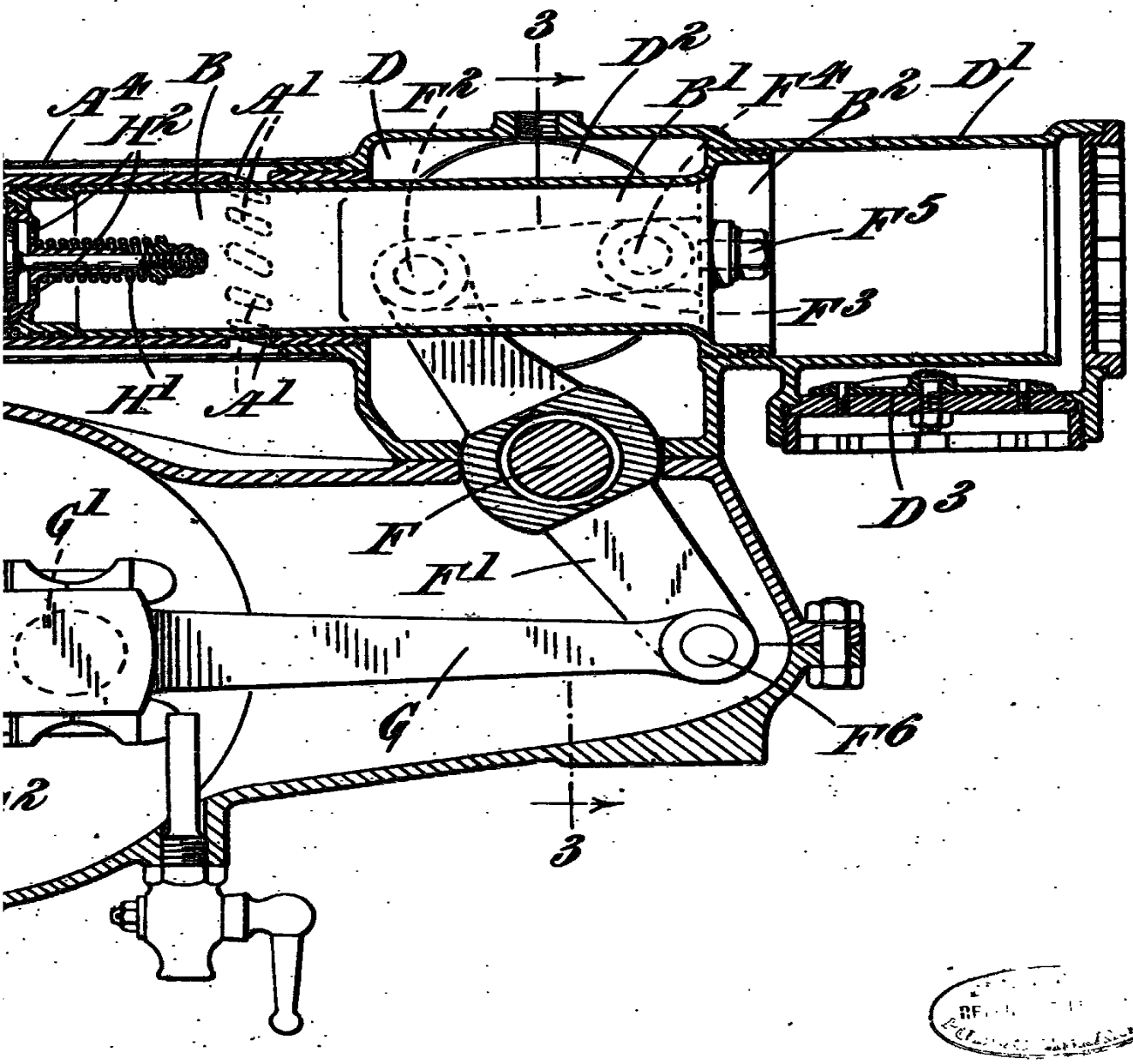


Fig. 1.

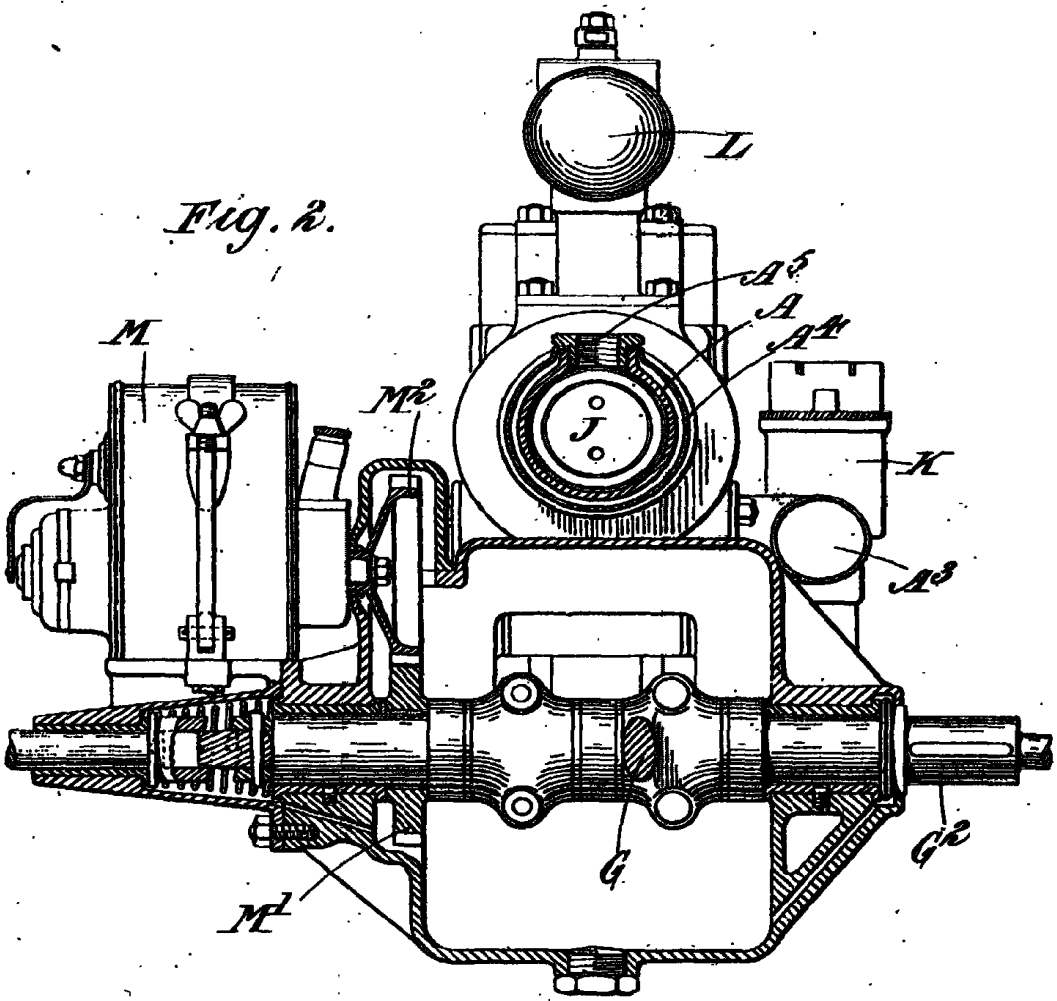


RE
PA

Malby & Sons, Photo-Litho

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 2.



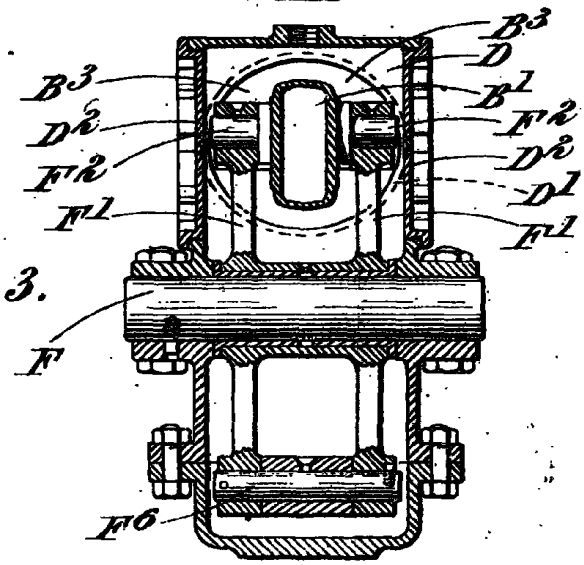


Fig. 3.

Malby & Sons, Photo-Litho.